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NOVEMBER 11, 1998

Mr. Bruce Halstad
U.S. Fish and Wildlife Service
1125 16th Street, Room 209
Arcata, CA 95521

Dear Mr. Halstad:

Subject: Comments relative to Pacific Lumber Company's Draft Habitat Conservation Plan.

I have reviewed the draft habitat conservation plan (HCP) and offer the following comments to you for your consideration.

PERSONAL QUALIFICATIONS: I am a private consultant with 29 years of professional Pacific Northwest working experience with salmon. I work with industries, land owners, institutions and agencies in identifying salmon habitat problems, appropriate conservation measures, and habitat enhancement opportunities. I began my work with salmon habitat issues as an Assistant Professor at the University of Washington in 1969. I researched and published on the early estuarine life history of pink and chum salmon in Puget Sound. I also studied zooplankton productivity in Puget Sound, coastal Oregon and Washington, and in the North Pacific Ocean. I related zooplankton density limitations for coho salmon smolts in Puget Sound and this resulted in changes in release timing of coho hatchery smolts in Puget Sound. Since 1972, I have been a private consultant and have worked for virtually all parties affecting and managing salmon and salmon habitat from California to Alaska. I was the project manager and senior author of the Klamath Basin Fishery Resource Plan for the Interior Department. This plan was subsequently funded by Congress and is in progress now. I have personally conducted hundreds of miles of stream and riparian surveys including extensive work in unmanaged areas in Alaska and managed areas in California, Oregon, Idaho and Washington. I presently coordinate a large forest industry sponsored stream habitat survey project in Oregon in cooperation with the Oregon Department of Fish and Wildlife. To date, we have quantitatively surveyed over 3,000 stream miles in coastal Oregon alone. I am an advisor to the Lower Columbia River Watershed Council, For The Sake Of Salmon, College of Forestry at OSU, and am a past advisor to the Department of Fish and Wildlife at OSU. I just served on the Alaska Department of Natural Resources Technical Committee that evaluated the Alaska Forest Practices Act and Regulations in terms of their adequacy to protect salmon habitat. I am very familiar with the scientific literature on forestry interactions with freshwater salmon habitat and riparian/stream functions.

PACIFIC LUMBER COMPANY DRAFT HCP IS VERY CONSERVATIVE: The draft HCP consistently appears to be based on conservative applications of the best available science. The legislative (State of California) amendments add further constraints and conservatism. For example, the recent empirical (not modeling) research on the effectiveness of riparian buffer zones to supply large woody debris (LWD) in streams (Martin et al. 1998) confirmed that the relative effectiveness of LWD to form habitat features is a function of channel type and the amount of LWD in the stream. LWD is most effective in affecting stream features in alluvial lower gradient channels (LWD formed 50 to 80% of the pools) and is less effective in forming pools in constrained higher gradient channels (only about 10% of pools). Spawning gravel features were more dependent on gradient but were also affected by LWD. In lower gradient alluvial reaches, LWD was associated with 40%of stable gravel bars while in higher gradient reaches only about 10% of gravel deposits were associated with LWD. These results are consistent with the findings of many other researchers. VWK-1

Perhaps more important, was the Martin et al. (1998) finding that maximal pool development (channel widths per pool) in alluvial channels was associated with an LWD load of 400 functional pieces per kilometer of stream length. Pool spacing related to LWD was finite (not infinite) and maximized at approximately three channel widths per pool. More LWD did not result in more pool development in alluvial channels. This finding is consistent with that of Montgomery et al. (1995) who showed that the lowest channel width per pool spacing occurred between 300 to 400 pieces of LWD per kilometer and consistent with Beechie et al. (1997) who reported the lowest channel width per pool spacing at 400 pieces of LWD per kilometer. In higher gradient constrained channels, pool development was not statistically related to LWD load (although LWD was associated with some 10% of pools so LWD had some effect but not a significant effect).

For maximum pool development in alluvial channels, Martin at al. (1998) found that the 400 pieces of functional LWD per kilometer was empirically related to a recruitable (of a minimum size capable of supplying functional LWD) riparian tree density of 235 trees per kilometer of stream length and further that 100% of these trees occurred within 20 meters of the stream (based on surveys of 38 riparian zones and more than 11,000 trees). In other words, 235 trees per kilometer of stream length in a 20 meter wide buffer would supply enough LWD to maintain maximum pool development. Tree densities were determined by natural stocking rates as these were not managed riparian areas (no prior harvest occurred in the studied riparian zones). So the ability of various riparian stands to supply maximal pool development via LWD recruitment varied naturally dependent upon natural constraints (such as soil moisture, geology and disturbance history). The Martin et al. (1998) study took place in coastal Alaska where tree heights are shorter than in the plan area. Plan area trees should be capable of supplying relatively more functional LWD from the same buffer width.

The draft HCP buffer widths are very conservative compared to the Martin et al. (1998) findings which are based on the most comprehensive LWD recruitment study to date. The draft HCP buffer widths are less than the FEMAT (1993) buffer widths. But the FEMAT buffer widths were set for multiple objectives. The FEMAT buffer widths were based on subjective judgments of desired buffer widths to accomplish salmon (and many other species) conservation entirely on federal forests. The following FEMAT quotes are relevant. "Incorporating Riparian Reserve Scenario 1 into Alternative 9 is expected to reduce the long term risk to aquatic and riparian habitat outside of Tier 1 Key Watersheds. ... would result in an 80 percent or greater likelihood of providing sufficient aquatic habitat to support stable well-distributed populations of the seven salmonid races/species/groups evaluated. ... The success of the strategy does not depend on actions on non Federal lands." Further, the FEMAT buffer widths are interim widths pending the outcomes of watershed analysis. The intent was to preserve flexibility in long term land management and it was recognized in FEMAT that buffer widths after watershed analysis could be narrower than the interim widths. VWK-1

In my professional judgment, the HCP will protect and over the long term will promote functional riparian and stream habitat for threatened coho salmon and will promote aquatic and terrestrial biological diversity in affected streams, riparian areas and watersheds. This will be accomplished in part through the protection and encouragement of important riparian - stream habitat functions in the plan area. Examples include canopy shade (temperature and humidity), large conifer woody debris recruitment (long term channel morphology complexity, overwintering habitat, sinuosity, sediment storage, substrate stability, etc.), bank stability (channel morphology, substrate and water quality, cover), floodplain roughness (sediment storage, substrate and water quality), floodplain protection (long term channel processes and complexity, secondary channels, ground water storage), litter fall (allochthonous food chain inputs), etc..

NATURAL GEOMORPHIC FEATURES AND NATURAL DISTURBANCES WILL LIMIT POTENTIAL STREAM HABITATS: Although the HCP will protect and encourage important riparian - stream functions, nature will still limit and affect all stream and riparian habitat features in the plan area. The protected HCP area streams and riparian areas will not be static. They will still be subject to natural disturbance events (gravity, fires, floods, windstorms) and associated natural disturbance processes and effects on stream habitat features. Natural disturbances are the rule not the exception but fortunately salmon species are highly adapted to widely varying disturbances in space and time. No one can predict what specific riparian and stream features will result other than that a range of features will result. And no one can predict exactly how long these stream features will last. Never the less, based on a relatively large scientific data base, desired (for coho and other salmon) stream habitat features should improve over the landscape within the plan area and plan area salmon habitat capacity generally should expand. Not all streams and stream reaches will have excellent salmon habitat and within a stream or stream reach the habitat may vary over time from good to excellent to poor, etc. We cannot predict all of the habitat outcomes VWK-2 but we can predict variability in space and time. Fortunately salmon are adaptable to a range of habitats and they constantly seek out "new" and improving or suitable habitats to exploit. VWK-2 CON.

DOWNSTREAM HABITATS MAY BE MORE CRITICAL FOR COHO SALMON THAN PLAN AREA STREAMS. SUBSEQUENT LIFESTAGE SURVIVALS MAY BE MORE CRITICAL: The resultant riparian - stream system should be more complex and promote more salmonid lifestage diversity which should theoretically add resiliency to coho and other salmon species persistence and recovery if subsequent lifestage habitats allow this. That is, if downstream freshwater, estuary and ocean habitats are not critical bottlenecks in local salmon population productivity. This brings up another important ecological fact. No one can prevent species extinctions. They have occurred for millions of years and will continue to occur. We can work to minimize and mitigate many human disturbances and even protect and restore desired critical habitat features for salmon. But nothing is constant in nature and many natural forces are beyond our limited ability to affect them. The 1964 flood is a good example that resulted in major changes in riparian and stream conditions in the plan area that have affected coho salmon productivity since then (some for the better and some for the worse).The natural decade - scale physical and biological processes in the North Pacific Ocean are another example. A third example is inland climate such as drought. VWK-3

INLAND CLIMATE AND OCEAN EFFECTS: The importance of inland climate and ocean conditions on salmon survival and run cycles has been poorly understood but a growing awareness of ocean and climate cycles helps shed light on our local coho, chinook, steelhead and searun cutthroat problems of late. This is most clear in coho salmon. Coho salmon catch from California to southern Washington (the Oregon Production Index Area, OPIA) increased modestly with the startup of the ocean troll fleet in the early 1920-era and then gradually declined to low levels in the early 1940-era. Coho catch was low but stable from then to 1960 when the catch dramatically climbed to a new record high by the mid 1970s. Coho catch has declined since then, very dramatically in the early 1990s. See Figure 1. The decline in coho catch is what most people understand as the salmon crisis in the Pacific Northwest. The catch decline and parallel spawner run declines is what prompted the National Marine Fisheries Service to list the California and Southern Oregon coho stocks under the Endangered Species Act. There was no salmon crisis during the 1940 to 1960 low catch period. The high abundance of coho salmon in the late 1960s and early 1970s created economic expectations that were part of the coho salmon problem that subsequently developed. VWK-4

The reasons for these coho productivity trends are discussed here as are similar trends in northern California and southern Oregon chinook stocks. Southern chinook (Rogue River south) catch was depressed in the early 1980s, rebounded in 1986 - 1988, but then declined again through 1993. Very high runs were then seen in the Sacramento, Klamath, and Rogue rivers in 1995 and 1996 and good runs in 1997. Different trends in northern Oregon and Washington chinook stocks, and B.C. and

Alaska salmon stocks are also briefly discussed because they are relevant.

VWK-4 con.

The increase in coastal coho catch from 1960 through 1975 can be explained by the development of good hatchery practices, expanded hatchery production, and perhaps most important very favorable ocean conditions. Hatcheries supplied up to 80 percent of the coho catch during this period. What caused the dramatic coho catch decline since then and the declines in spawner runs? Hatchery production actually increased slightly in the late 1970s and then remained fairly constant. Hatchery practices generally steadily improved. Forestry and agriculture land use practices and wastewater treatment steadily improved in the region. Catch should have increased or at least continued at the high mid 1970s level but instead it progressively declined. Spawner runs were a virtual disaster in the early 1990s. Why? The answer can only be a combination of inland climate and related ocean conditions.

VWK-5

CLIMATE: People from Northern California are very aware that they were in an almost continuous drought, a warm and dry cycle, from the mid 1970s through 1992. The years 1977, 1978, 1981 were notable drought years and from 1987 to 1992 were the second driest in recorded California history (Nash 1993). Warm and dry inland climate adversely affects salmon stream habitat. Stream elevations are lower, pools are shallower, side channels are often dry, transported sediment tends to be deposited, salmon habitat on aerial and volume bases are significantly lower, and stream temperatures are significantly warmer. The warmer stream conditions generally favor freshwater predators of juvenile salmon and they must eat more when the waters are warmer. Warm and dry inland climate results in significantly lower freshwater survival for juvenile salmon (all species) and for adult spring chinook salmon. And similar adverse low flow and temperature effects adversely affect the estuary survival of out-migrating salmon smolts. The adverse temperature effect is clearly evident in Klamath River records (Richert and Olson 1993), as is the lowered flow/reduced available habitat effect (Bureau of Reclamation records). In combination the warmer temperature and lowered hydraulic flows must have adversely affected the relatively small Klamath River estuary as well. Similar low flow and elevated temperature impacts occurred in the Sacramento River and in the Rogue River in Oregon (USGS Internet records) and the combined warmer temperatures and lowered flows must have adversely affected estuary conditions in those two systems as in the Klamath River. All coastal California streams and estuaries (including the Eel River and the Humboldt Bay tributary streams) must have been adversely affected by these warm and dry conditions extant from 1976 to 1993.

Beginning in 1993, the drought period appeared to be ending and remarkable chinook salmon rebounds were seen in the Sacramento, Klamath and Rogue Rivers in 1995 and 1996. The 1995 Klamath River fall chinook run was 200,000 adults with 150,000 natural spawners. The natural spawner goal is 97,000 adults, a level not seen since the 1960s. So the 1995 Klamath run was phenomenal. And the 1995 Rogue River runs reached levels not seen since the mid 1980s. The southern chinook rebound cannot be answered by improved freshwater conditions related to inland climate alone. And they cannot be linked to any significant land or water use changes because there weren't any in California or Oregon. And finally the majority of these southern chinook salmon were hatchery fish which were sheltered from the potential effects of land and water uses. VWK-5 con.

OCEAN EFFECTS: Inland climate effects are not separated from ocean effects as the atmosphere and ocean are interconnected. One cannot separate them for many physical observations. The surface temperature of the northeast Pacific Ocean gradually began to increase in 1970 and there was a major change in the northeast Pacific Ocean current patterns in 1976 (Bernal and McGowan 1981; Chelton, Bernal and McGowan 1982; McLain 1984; Pearcy 1992; Graham 1995; Barry et al. 1995; and Roemmich and McGowan 1995). As the northeast Pacific Ocean has warmed in the last two decades, there have been invertebrate species shifts (for example southern species are moving northward in the intertidal zone, Barry et al. 1995). Phytoplankton and zooplankton production in the California Current (the marine home of our coastal coho and southern chinook salmon) have been decreasing as waters have warmed, the California Current has slowed and weakened, stratification has increased, upwelling has decreased, and nutrients have been more and more limited. The nutrient limitation has resulted in significantly lowered primary and secondary productivity in the California Current critical for plan area coho salmon. See the above citations in this paragraph plus the excellent recent article by McGowan et al. (1998). Marine birds and mammals have been seriously impacted as well and many marine fish and invertebrate species have shifted their distribution northward (ibid). Murre seabirds have been adversely affected. They have declined drastically since the late 1970s (Takekawa et al. 1990, Pryne 1994). And macrozooplankton, Murres, baitfish, and oysters are not the only marine species to have been adversely affected in our ocean waters. Oregon pink shrimp, English sole, petrale sole and other fish catches have been similarly adversely affected. VWK-6

Zooplankton production has declined over 70% in the past two decades in the California Current, with similar declines in larval fish biomass (McGowan et al. 1998). Roemmich and McGowan (1995) calculated up to an 80% reduction in zooplankton biomass since the mid 1970-era. Per classical ecological theory (Odum 1959), a 70% decline in zooplankton production results in a 70% reduction in predators dependent on zooplankton directly and in their food chain (such as coho salmon) while an 80% reduction would result in a food supply that could only support 20% of the prior predator biomass (such as coho salmon). These ocean changes have measurably impacted the marine survival and growth of both coastal coho and southern chinook salmon. Preferred prey for juvenile coho salmon in the California Current have declined in abundance and in their diet over the last 20 years (McGowan et al. 1998). The adverse marine conditions are most notable in coastal coho salmon. We do not have direct measurements or estimates of marine survival for wild salmon populations at this time. The best indicator of marine survival is derived from hatchery coho return and catch data (available from mini-OPI packet data from LeFleur, WDFW, 1998). For the period from 1965 to 1975, the average coho marine survival was 6.7%; from 1976 to 1990, the average coho marine survival was 3.2%; from 1991 to 1997 the average marine survival was only 1.2% (Figure 2). Applying classic food chain dynamics theory, a 70% reduction in the coho salmon food base, should result in a predicted coho salmon marine survival rate of 2%. An 80% food base reduction results in a predicted coho salmon marine survival rate of 1.7%. The observed empirical average marine survival rate from 1991 to 1997 was 1.2% (compared to the 6.7% average from 1965 - 1975). The observed survival rate (1.2%) was less than predicted (1.7 to 2%) but very close based on a reduced food supply alone. A change in the predator population, such as a shift northward in the distribution of Pacific mackerel which was also observed, could easily account for the additional coho salmon survival decline.

VWK-6 con.

Kaczynski (1994) derived the minimum marine survival for coastal coho salmon needed to to at least maintain their population level (no increase or decrease). This was done by an application of the net replacement rate (Birch 1948, Caughley 1967). At equilibrium when the net replacement rate is one, one adult female is replaced by an adult daughter in the course of one generation. In salmon population dynamics, adult returns are the best index of productivity. The minimum marine survival for coastal coho salmon is 2.7%. Coho marine survival was so poor in 1976, 1983, 1984, 1986, 1989, 1991, 1992, 1993, 1994, 1995, 1996, and 1997 (smolt entry years) that coho salmon populations probably would have declined naturally even if there were no salmon fishing seasons based on hatchery survival estimates as indicators of wild coho marine survival (all under 2.7% in those years). The net replacement rates in these years was less than one. The marine survival estimates are reasonable and they have a high correlation with the jack salmon index used to set salmon fishing seasons (86% of the variation is explained, Figure 3).

The marine survival estimates also have a high correlation to the Willapa Bay oyster condition index (degree of oyster meat inside an oyster shell). See Figure 4. California and Oregon coho salmon do not eat Willapa Bay oysters. Common adverse marine factors are affecting both Willapa Bay oyster plumpness and coastal coho salmon marine survival: namely warmer marine temperatures, stronger stratification, reduced nutrient availability, and consequently lowered primary productivity (and then lowered secondary productivity for the coho salmon). And the body size of coastal coho salmon has been adversely affected as well. From 1970 to 1975, the average weight of troll-caught coho salmon was 8.2 pounds, while from 1976 to 1991, the average weight was only 6.2 pounds (dressed weight corrected to whole weight in September from PFMC annual catch data records). Reduced body size in salmon means less eggs per female. So the net replacement rates of coastal coho salmon have been further adversely affected beyond just the reduced marine survival.

So we have had a triple negative effect: adverse inland freshwater survival, estuary survival, and ocean survival all related to natural environmental variability since 1976. Two alternate hypotheses can explain these inland climate and ocean effects. The first hypothesis is "simple" 20 to 40 year linked ocean and climate cycles. Fisheries scientists have discovered similar cycles going back over 200 years in California

Current bottom sediment core samples. The cycles are reflected in changes in abundance in the scales of Pacific herring, saury, hake, sardine and northern anchovy in distinct sediment layers (Smith 1978). All five species fluctuated in unison in these cycles. Nickelson (1986) continued the observation on the abundance changes in northern anchovy and showed that its trend corresponded with coho salmon abundance. Nickelson showed that coho had their highest marine survival in years that had the coolest ocean waters and the highest upwelling. Figure 5 shows the decade-scale sea surface temperatures in the near-shore ocean off Coos Bay, Oregon and the very significant warming trend apparent there since 1976. Figure 6 shows the upwelling cycle and the significant downward trend in upwelling since the mid 1970s.

VWK-6 CON.

El Nino events compound the adverse decadal increasing warm water effect (Jacobs et al. 1994, McGowan et al. 1998) and during El Nino events we see a significant increase in warm water predators such as Pacific mackerel. Figure 7 shows decade-scale patterns in the Southern Oscillation Index, an index of El Nino events in the northeast Pacific Ocean. El Nino events occur when the oscillation index is negative and the strength of the EL Nino increases as the index gets more negative. In a sense, we were in an almost constant El Nino from 1976 to present. Macrozooplankton production has decreased some 70 to 80% in the California Current (80 % in Roemmich and McGowan 1995, 70% in McGowan et al. 1998) in the period from 1976 , baitfish are significantly lowered in abundance (Nickelson 1986), and seabirds have been adversely affected as well. The California Murre (Auk seabird) has declined over 50% in abundance and the Washington Murre population has declined over 80% because of adverse marine conditions (Takekawa et al. 1990, Pryne 1994). The seabirds in the Southern California Bight declined 90% in this 20 year period (McGowan et al. 1998). These adverse impacts have resulted because of the decade - scale changes in the California Current exacerbated by El NIno events. Interestingly when we have warm - dry inland climate and warm - poor ocean conditions in California, Alaska has a warmer more productive ocean effect. The Alaska Current became stronger in 1976 and more stratified since then. Alaskan waters are more light limited for primary production (compared to more nutrient limited for the California Current). The increased stratification in the Alaskan Current has resulted in increased primary and secondary production (McGowan et al. 1998). And Alaska has had increasing salmon survival since 1976 and record salmon catches in the last several years. They had poor salmon survival and poor catches from the 1950s to mid 1970s when we had better ocean conditions, a stronger California Current with less stratification and more available nutrients for primary production, higher zooplankton production, and better marine growth and survival for coho salmon.

There is some evidence that changes in the southern portion of the California Current began in 1994. Upwelling markedly improved and ocean waters were cool all the way to Mexico. Southern chinook salmon were caught off Mexico in 1995 and 1996, both good ocean years for southern chinook stocks with a greatly increased ocean pasture area. This shift in the southern portion of the California Current helps explain the southern chinook stock rebound. Inland climate and ocean conditions were both advantageous for these southern chinook year classes. There is some evidence that Southern Oregon and Northern California coho salmon also began to exhibit increased survival relative to Northern Oregon coho salmon. And we appeared to be moving into a cool wet inland climate cycle beginning in 1995. VWK-6 con.

Canadian and Japanese scientists have made serious observations on declining salmon productivity in the North Pacific Ocean (Welch, Chirgrinsky and Ishida 1995). The North Pacific Ocean can be compared to a pasture for north migrating salmon stocks (our Pacific Northwest coho and southern chinook stocks are stay at home fish compared to northern chinook and steelhead stocks). The maturing juvenile salmon have relatively strict southern limits for their suitable pasture determined by temperature. In particular, the winter southern temperature is more critical apparently related to low food abundance and the critical temperature band has been creeping northward since 1976. This is shrinking the available northern ocean pasture for salmon. These researchers predict that if the increasing temperature trend continues, all salmon from California, Oregon, Idaho, Washington, British Columbia, and southeast, southcentral and southwest Alaska will be extinct by the year 2020. Only salmon stocks in the Bering Sea and Arctic Ocean will survive the warming trend. Welch, Ishida and Nagasawa (In Press) reviewed over 40 years of salmon sampling records (1956-1996) in the North Pacific Ocean (N = 20,397 observations). Their review confirmed the sharp thermal limits of salmon at sea, especially the critical winter thermal limits. Their expanded study and sea surface temperature modeling reinforces the prediction that the upper thermal (southern) limits for salmon will shift into the Bering Sea by mid next century.

WHAT IS PRIMARILY LIMITING PLAN AREA SALMON POPULATIONS?: There is an implicit assumption in the draft HCP that freshwater stream conditions are limiting coho salmon production. This assumption was also implicit in the listing of this ESU by the National Marine Fisheries Service (NMFS) and in the designation of critical habitat by NMFS. More recently NMFS (1998) now acknowledges that adverse inland climate and ocean conditions are at least partly responsible for observed population declines of salmon. And the above discussion demonstrates this for coastal coho salmon. When one examines observed year to year differences in adult returns (the most traditional population parameter used to evaluate population responses in salmon and the population parameter that integrates the often more highly variable lifestage survivals) over the last few decades, one cannot account for observed adult return variability year to year by any significant changes in freshwater habitats. The most constant lifestage habitat for salmonids in northern California and the Pacific Northwest over the past thirty years has been the freshwater spawning and rearing areas. And if anything these freshwater salmon habitats have been gradually improving in quality over the landscape over the last three decades. This has to be true with the advent and then continuous improvements of state and federal forest management practices, agricultural conservation practices, wastewater treatment advances, etc. Freshwater habitat variability cannot explain the high variability observed in returning adult VWK-7 salmon counts over at least the last three decades. And the limited historical records indicate great year to year variability in adult returns before extensive forest utilization began. Further, one observes the same general year to year variability patterns in undeveloped as well as managed watersheds. And, especially, freshwater habitat variability cannot explain the recent two decade coho salmon run declines that precipitated the NMFS concern and ESA action. In contrast, adverse inland climate and ocean variability can explain much of the observed variability in adult returns over the last thirty years and the recent productivity declines.

VWK-7 con.

BROAD NORTHEAST PACIFIC OCEAN DECADAL CHANGES/TRENDS: Recent advances in computer data base management (EarthInfo Comprehensive Ocean - Atmosphere Data Set - COADS Global Marine Database Version 1998) have made sea surface temperature (SST) information for the northeast Pacific Ocean more readily available for analysis. Summaries of annual SST data (weighted average values) are presented here for five selected locations: off mid to northern California, Oregon/Washington coasts, Vancouver Island, southeast Alaska, and the Gulf of Alaska. These locations were selected as representing portions of the northeast Pacific Ocean available for portions of the marine residence of various Pacific salmon populations. Figures 8 - 13 present annual SST trends at these nearshore and Gulf of Alaska locations for the period of record 1950 through 1995. These data include all available empirical SST records (49,029 monthly summarized records for these selected locations). Weighted average values were derived for months and then years for these locations. Available records were irregular in occurrence and simple averages could have distorted annual average values toward more heavily sampled seasons. Irregularities in the frequencies of sampling locations (not random or stratified) could still bias annual trend results somewhat.

The SST trends are revealing and do help us in understanding salmon adult return trends. First, distinct temperature latitude differences are apparent for the selected locations (Figure 8). Latitude differences were anticipated and the distinction in the derived data sets was reassuring. Second, two distinct decade - scale temperature trends are evident for all five selected locations. Third, the decade - scale temperature trends are the same (are highly correlated) for all five locations, California to Alaska. There was a warming and then cooling trend from 1950 to about 1970 and then an almost constant warming trend to the present. There was a mid 1980-era cool node within the second warming trend. The magnitude of the two temperature trends varied somewhat from location to location. The two decade - scale trends for mid to northern California for example are less distinct than for the other locations and the trends off Vancouver Island are more pronounced.

These SST trends and location results reveal significant productivity limitations for Pacific salmon populations. For example the synchrony of the trend patterns over such a large geographical area (the northeastern Pacific Ocean) helps explain the synchrony in steelhead run strengths observed by WDFW (1992) and for chinook salmon stocks reported by many researchers. The range in average SST (eg., year to year variability) for this time period (5 decades) was generally only two degrees Celsius (C) for all locations except Vancouver Island where it was three degrees. These are relatively very narrow average annual temperature differences compared to annual temperature variability in freshwater. This indicates that marine organisms (including the marine lifestages of salmon) probably have adapted very narrow temperature tolerance limits compared to freshwater. VWR-7 con.

The generally warm nearshore ocean conditions off mid to northern California (Figure 9) strongly imply a marine temperature limitation for the southern limits of their ocean distribution. This southern range limit apparently differed year to year and decade to decade naturally as indexed by the average annual SST values. 1952, 1955, 1970 and 1990 (at least) were probably better productivity years for the marine lifestage of coastal coho salmon then other years of record. These results help show why upwelling is so critical (beneficial) to California coho stocks.

The offshore Oregon/Washington SST trends (Figure 10) are more distinct than those off California but less distinct than those to the north. Results verify the recent warming trend reported by many authors (ie., since 1976) but show that the warming trend actually began about 1970 (with a cool 1975 that was also present at the other locations). The available record now reveals other warm years as well. Twelve degrees C appears to separate good marine production years (below 12 C) from poor production years (above 12 C) for this marine region on an average annual basis.

The SST trends at the other locations also help explain observed salmonid productivity variability. These results are helpful in understanding marine limitations for coho salmon survival, catch trends, and adult returns. The southern chinook and coho stocks face real ocean limitations on an almost constant year to year basis. They truly are at the southern edge of their distribution. These stocks are highly dependent upon upwelling to cool local waters and replenish nutrients for biological productivity. These stocks should exhibit high annual variability in adult return rates.

BRIEF SUMMARY: The draft HCP is based on very conservative applications of the best available science. Plan area streams can be expected to improve with time in habitat and water quality over the plan area landscape. Nature will still impose limitations and natural disturbance forces will help create a diversity of stream habitats in the plan area. This diversity of stream habitat features should increase more salmon lifestage diversity which should theoretically add resilience to coho and other salmon species persistence. Not all stream habitats will be excellent or even good for salmon lifestages and stream habitat features will not be static over time. Natural disturbances will be the rule not the exception.Salmon are highly adapted to disturbances and are resilient.

Downstream lifestage habitats may be more critical than plan area habitats for coho and other salmon species. In particular, adverse marine conditions extant since the mid 1970-era appear to have been a true limiting bottleneck for coastal coho. Physical and biological changes, in particular the documented food chain productivity decline, can account for much of the observed productivity declines in coastal coho salmon and northward shifts in predator distributions (such as Pacific mackerel which has also been documented) could easily account for the remaining coho productivity decline. Climate and ocean effects are critical natural disturbances for coho and other plan area species. Natural variability appears relatively ignored in the DEIS and emphasis on plan area streams appears over stated. Never the less, if climate and ocean cycles become once again more favorable for local salmon, and downstream river and estuary habitats are not critically limiting (or can be improved), the local salmon production potential should be expanded by the actions proposed in the draft HCP.

I sincerely hope that my comments will be helpful to you and your associates in your final EIS work.

Respectfully submitted,

VW Kaczynski

V.W. Kaczynski, Ph.D.
Certified Fisheries Scientist

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Figure 1

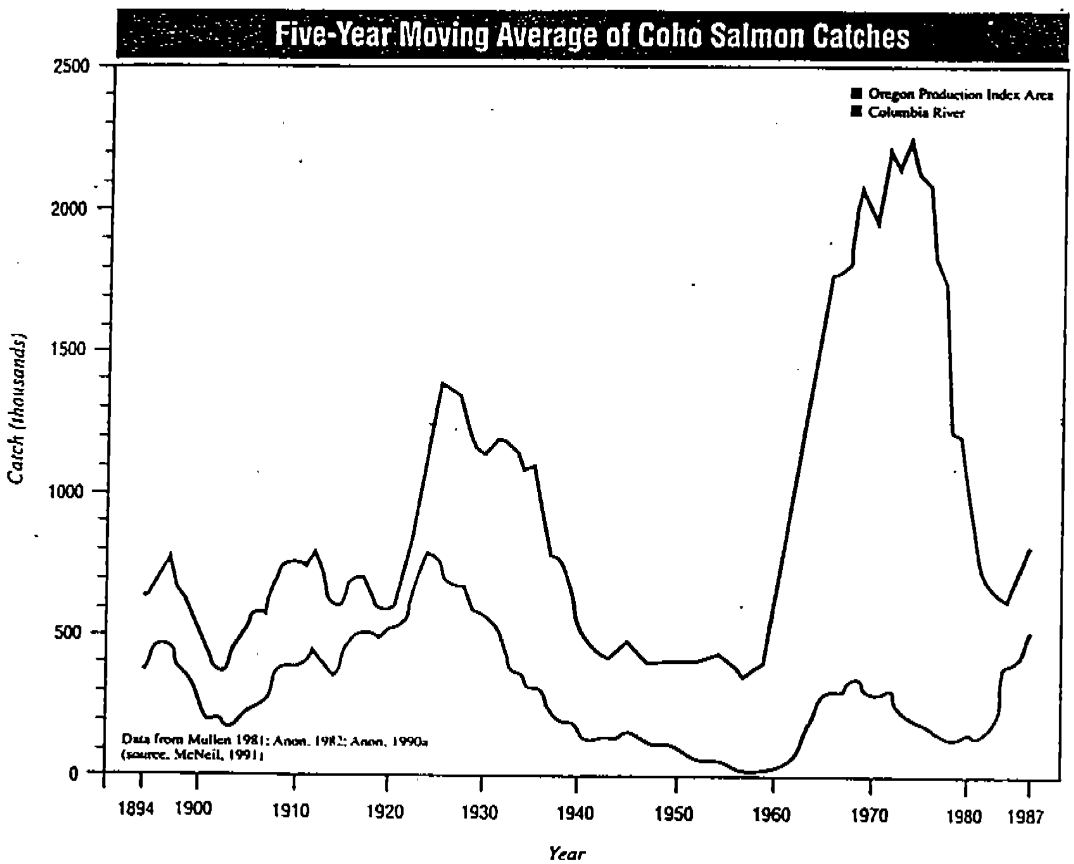
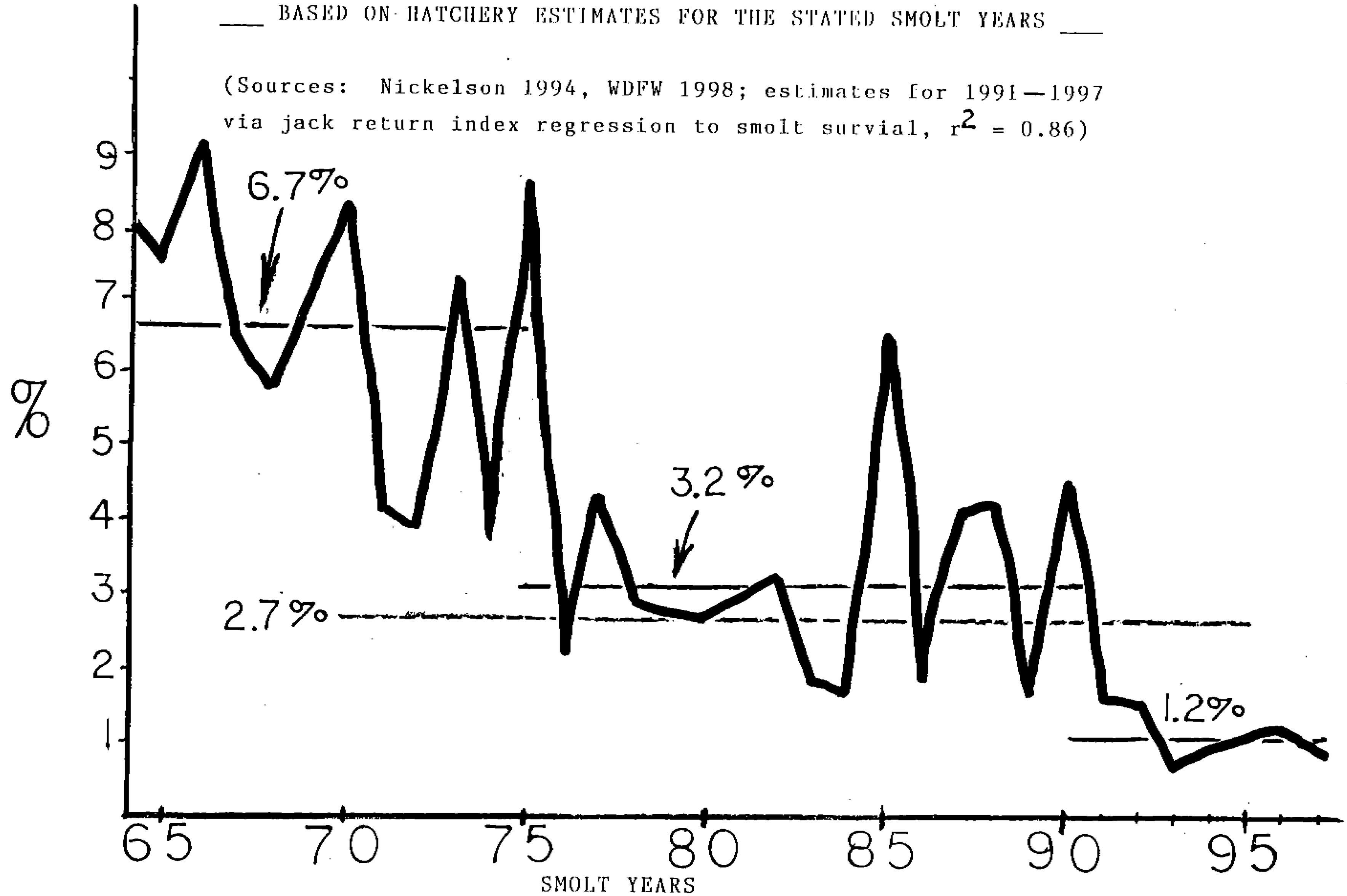

Five-Year Moving Average of Coho Salmon Catches
Oregon Production Index Area
Columbia River
Catch (thousands)
2500
2000
1500
1000
500
0
Data from Mullen 1981; Anon. 1982; Anon. 1990a
(source, McNeil, 1991)
1894
1900
1910
1920
1930
1940
1950
1960
1970
1980
1987
Year

FIGURE 2.

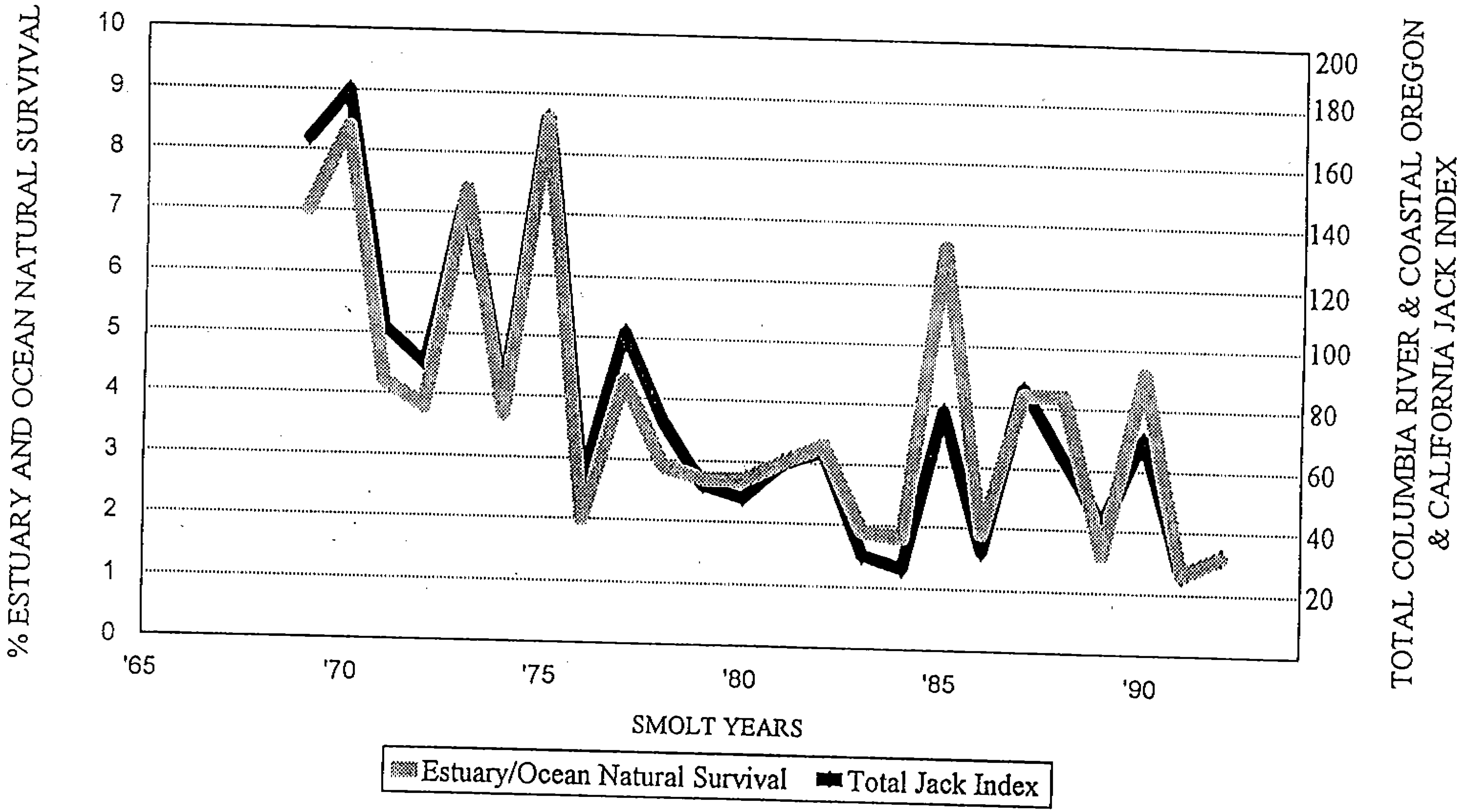
COHO SALMON MARINE SURVIVAL FOR THE OREGON PRODUCTION INDEX AREA
___ BASED ON HATCHERY ESTIMATES FOR THE STATED SMOLT YEARS ___

(Sources: Nickelson 1994, WDFW 1998; estimates for 1991—1997 via jack return index regression to smolt survial, $r^2 = 0.86$)



Notes: horizontal lines are averages for those years. 2.7% is estimated minimum survival needed to maintain population.

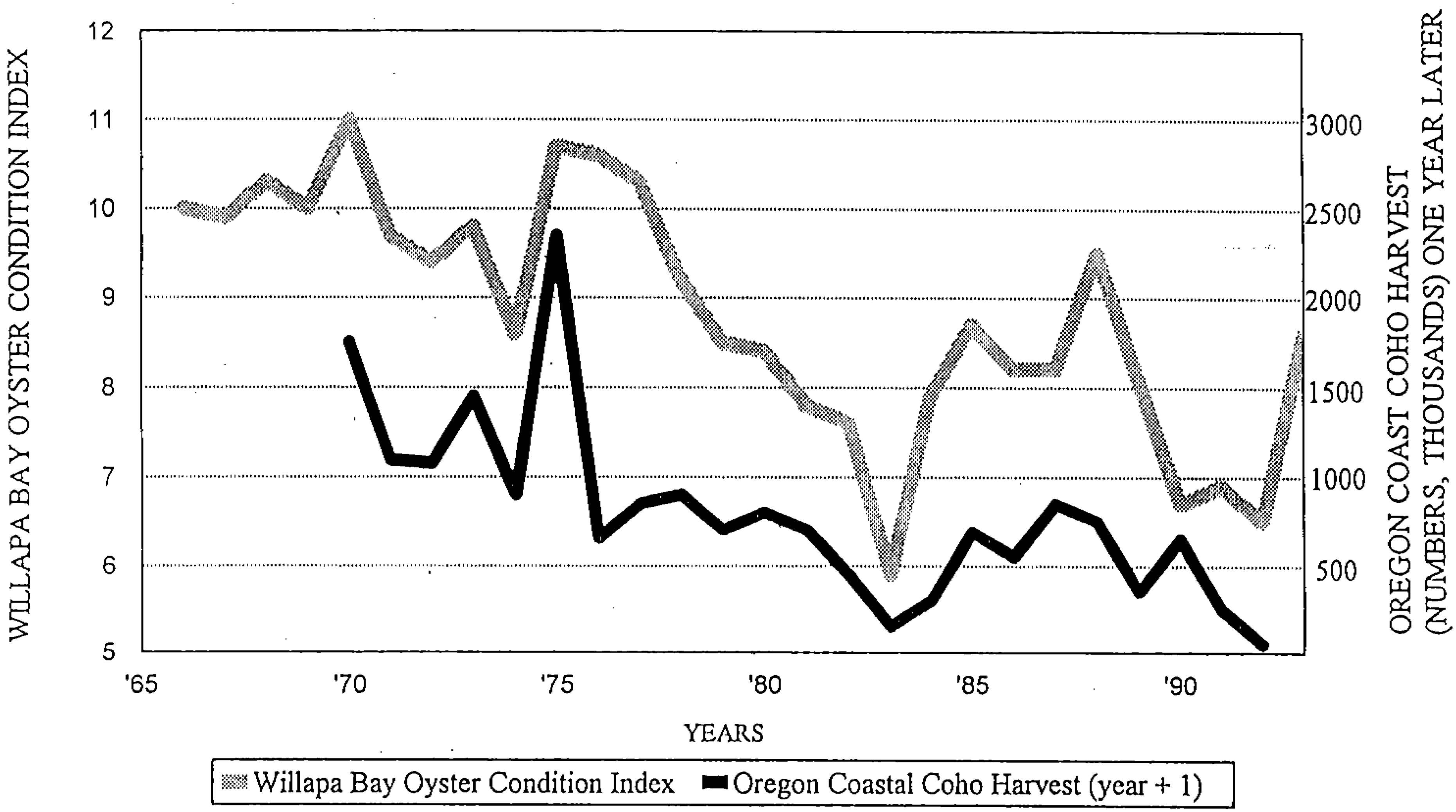
Figure 3 . ESTUARY/OCEAN NATURAL SURVIVAL ESTIMATES (FROM HATCHERY FISH) AND TOTAL JACK INDEX VALUES FOR THE SAME SMOLT YEARS (TWO INDEPENDENT ESTIMATES)



Correlation $r_2 = 0.856$

Sources: See Fig. 1 for marine survival estimates; LeFleur (WDFW) 1994 for jack index values (mini OPI packet).

Figure 4. WILLAPA BAY OYSTER CONDITION INDEX AND OREGON COAST HARVEST OF COHO SALMON CALIFORNIA CURRENT EFFECT



Sources - PFMC 1991, 1984; Bodenmiller 1994; WDFW 1994

FIGURE 5. NEARSHORE ANNUAL SEA SURFACE TEMPERATURES OFF CHARLESTON, OREGON (3 YEAR MOVING AVERAGE). HORIZONTAL LINES ARE AVERAGES FOR THOSE YEARS. SOURCES: ODFW 1995, NOAA 1998.

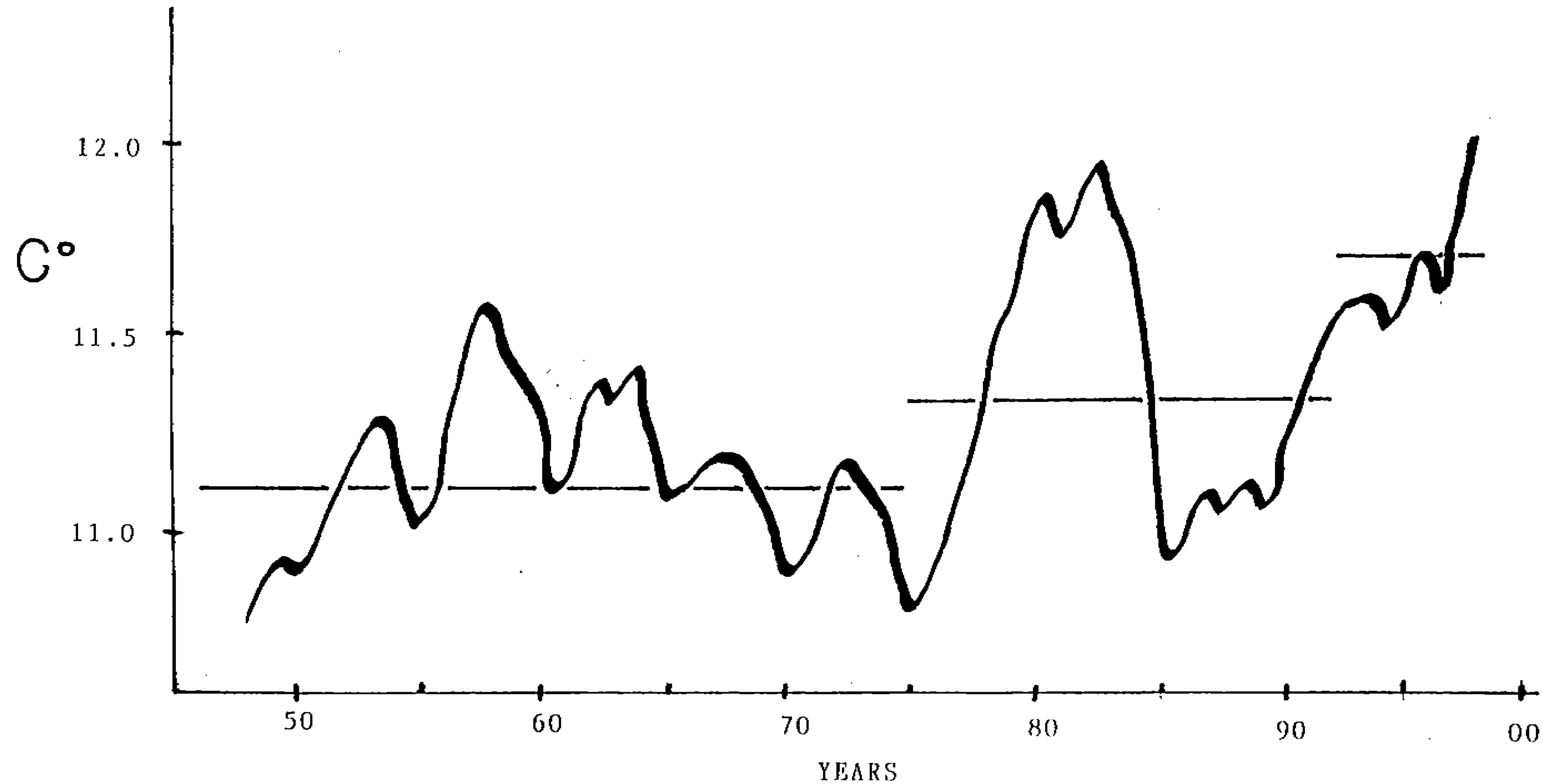
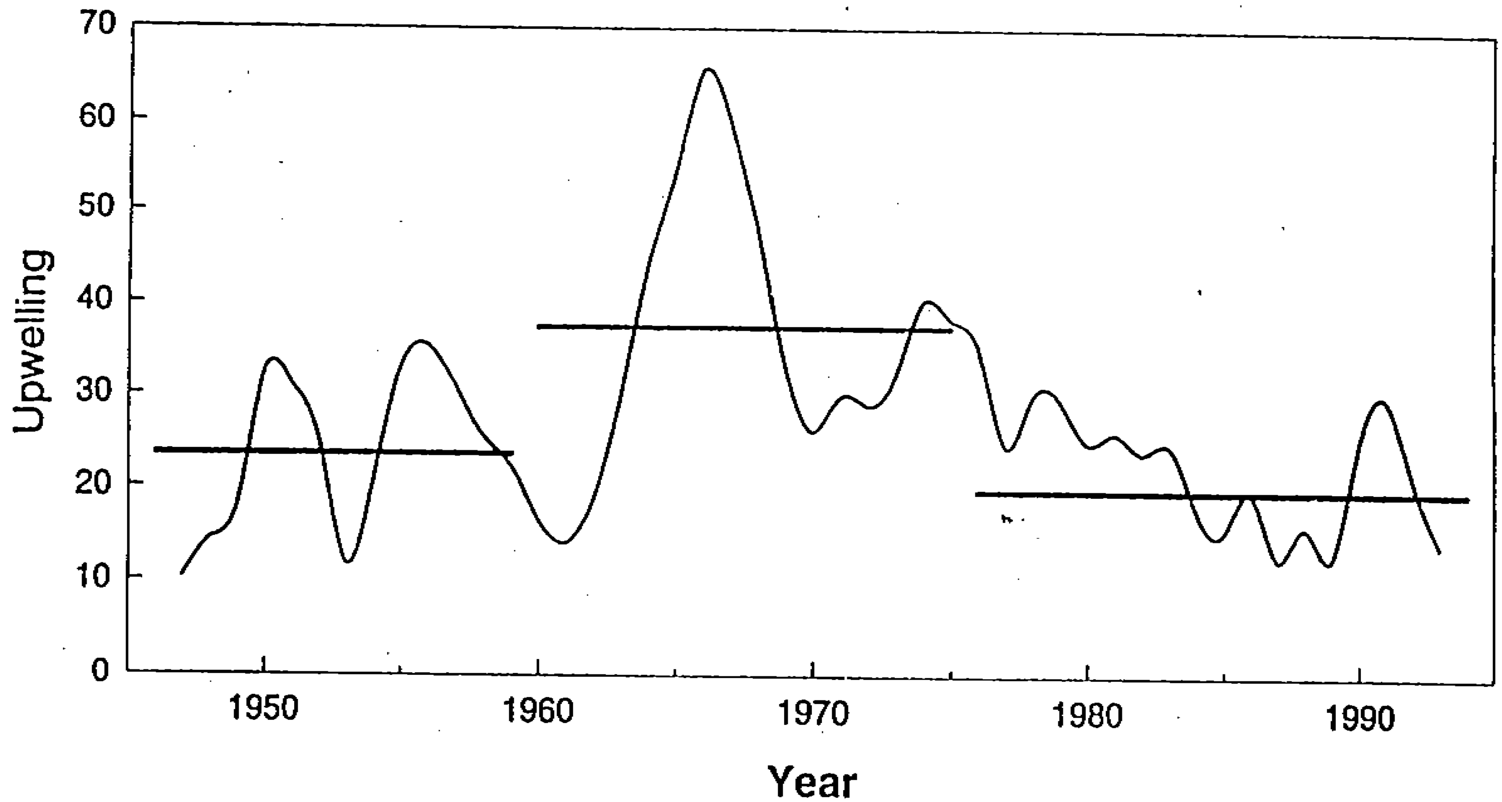


Figure 6.

Bakun Upwelling Index 45° N Latitude

April - June 1946-1994

3-year moving average with mean values for 1946-59, 1960-75, and 1976-94



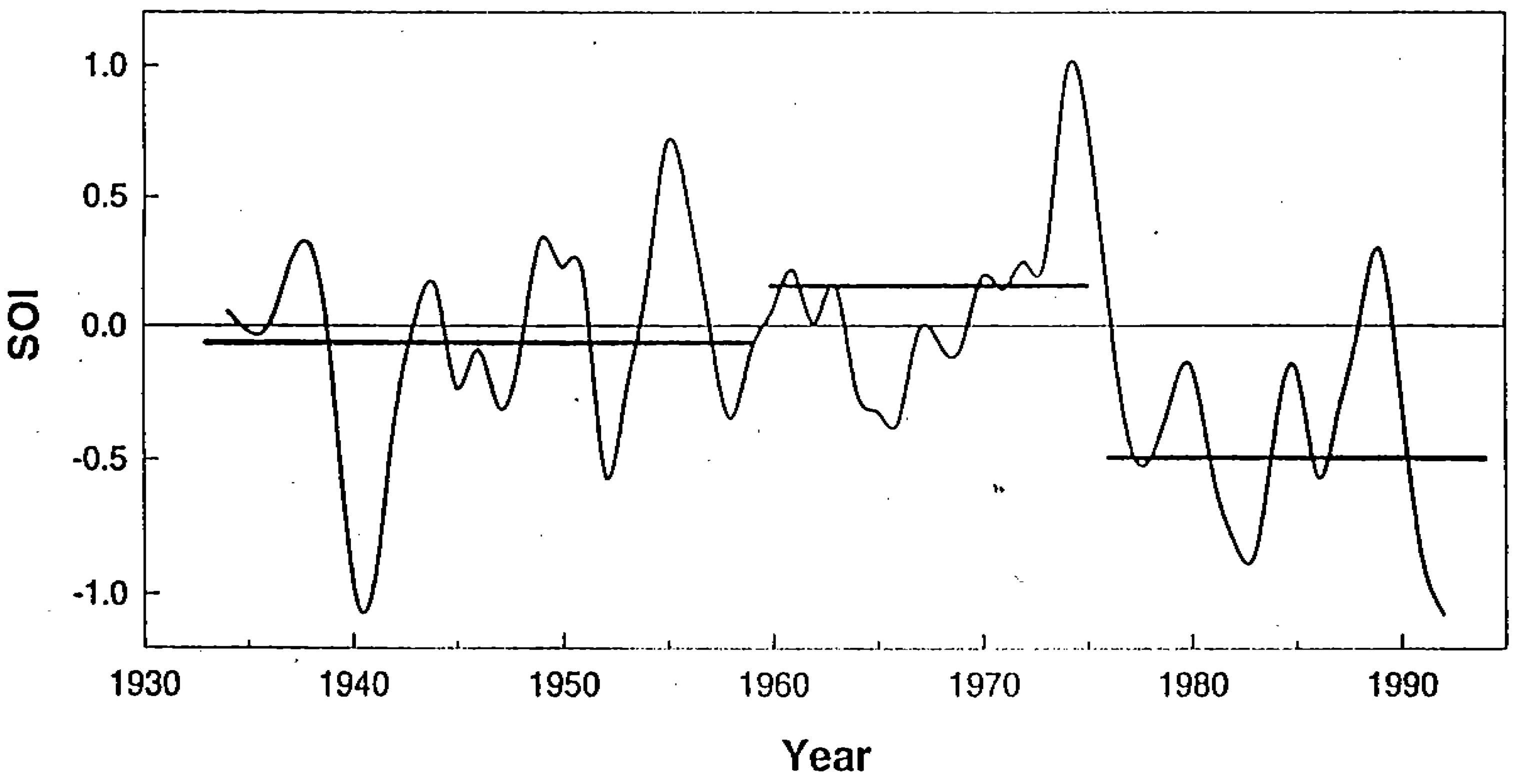
Source: ODFW 1995

Figure 7.

Southern Oscillation Index

1930-1993

3-year moving average with mean values for 1933-59, 1960-75, and 1976-93



Source: ODFW 1995

FIGURE 8.

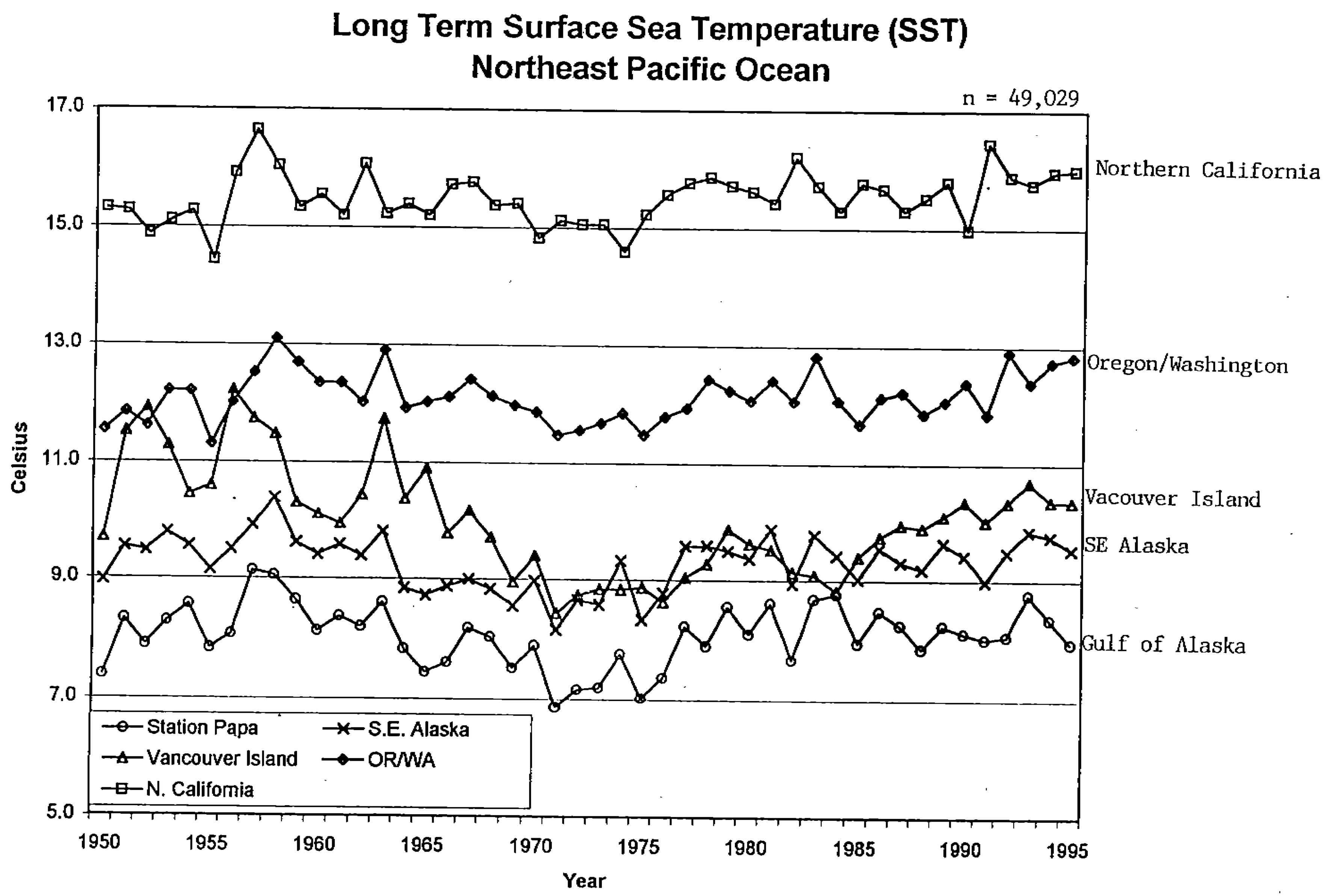

Long Term Surface Sea Temperature (SST)
Northeast Pacific Ocean
n = 49,029
Celsius
17.0
15.0
13.0
11.0
9.0
7.0
5.0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
Year
Station Papa
S.E. Alaska
Vancouver Island
OR/WA
N. California
Northern California
Oregon/Washington
Vacouver Island
SE Alaska
Gulf of Alaska

FIGURE 9.

Long Term Surface Sea Temperature (SST)
Northern California

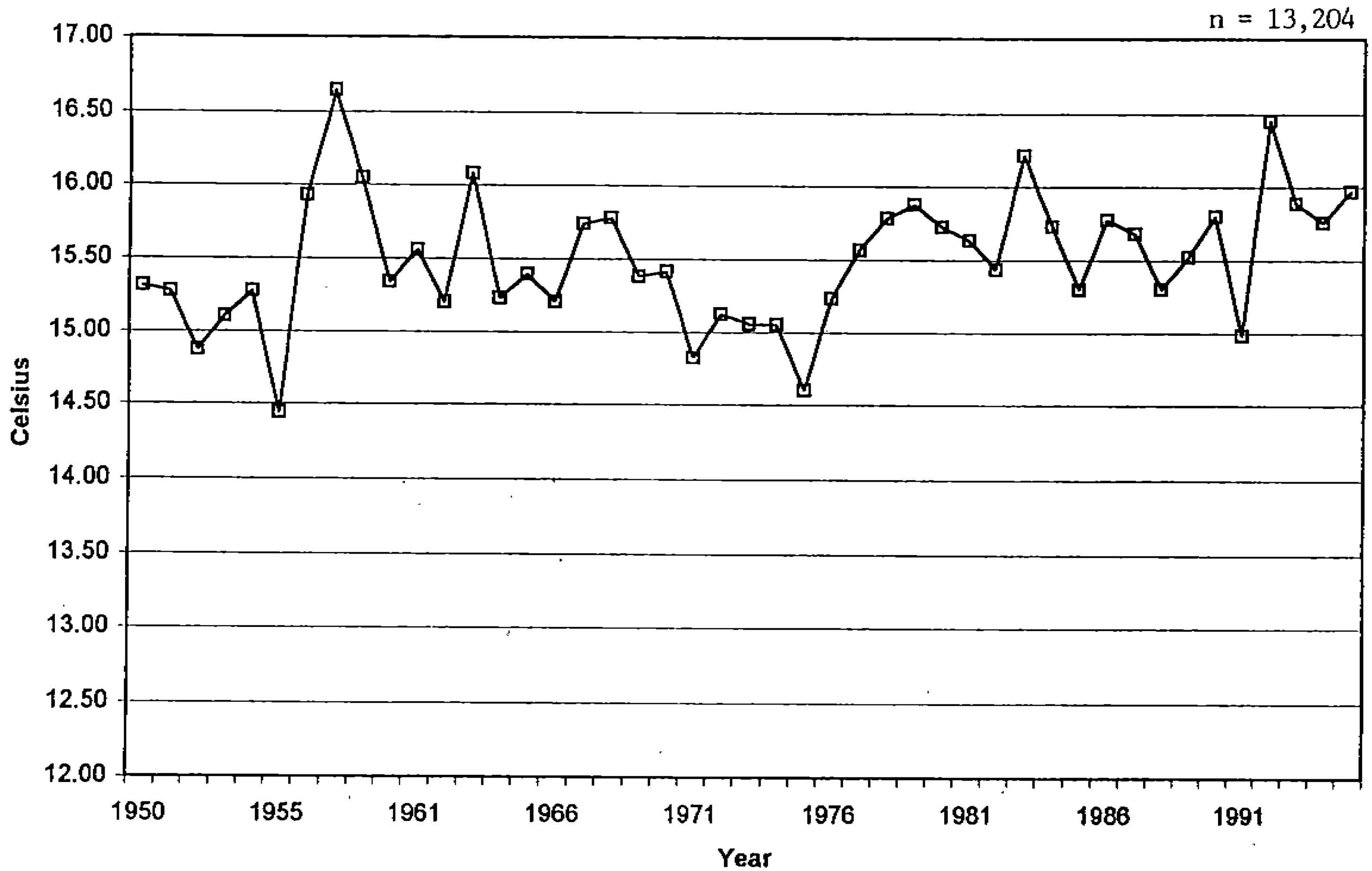


FIGURE 10.

Long Term Surface Sea Temperature (SST)
Coastal Oregon and Washington